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SOURCE Informativni prirucnik o Jugoslaviji, Book 1, Section 9, 1950.ELECTRIFICATION OF YUGOSLAVIA

The following report is [] taken from the Informativni prirucnik o Jugoslaviji, a handbook published irregularly since late 1948 by the Yugoslav Directorate for Information. Appended maps show electric power plants in Yugoslavia and sources of hydroelectric power; a graph shows construction of high-tension lines.

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Today, all basic sources of power, such as coal, petroleum, natural gas, water, and wood, are utilized for the production of electric power. Instead of utilizing all kinds of coal for electric power production in thermal power plants as in prewar Yugoslavia, new Yugoslav plants are utilizing waste from brown coal (mine waste and dust) and lignite.

Petroleum, natural gas, and wood are being used for the production of electric power to a small extent, mostly in numerous small electric power plants of local importance which are gradually going out of operation because of being incorporated into the general electrification network.

Electrification of present-day Yugoslavia is based upon utilization of water power, since Yugoslavia is very rich in water power. A survey of available water power resources is now in progress, but recent estimates indicate that the water power potential of Yugoslavia, at an average water flow, is about 12 million kilowatts. Economically utilizable water power is estimated to be approximately 9.1 million kilowatts, with a possible production of 40 billion kilowatt-hours of power.

The following table shows electric power production between 1918 - 1939:

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Production of Electric Power in 1918, 1931, 1937, 1939

(million kw-h)

<u>Year</u>	<u>Population</u> (millions)	<u>Hydroelectric</u> <u>Power</u>	<u>Thermal Electric</u> <u>Power</u>	<u>Total</u>	<u>Per Capita</u> (kw-h)
1918	11.5	285	165	450	39
1931	14	291.5	493.5	785	56
1937	15.28	450	462	912	60
1939	15.5	538	562	1,100	71

The above table shows that the average annual increase in electric power production in prewar Yugoslavia was about 6.5 percent annually and the average per capita increase in population was about 3.7 percent annually.

The following tables show the number of electric power plants, their capacity, purpose, and type, and their average capacity per plant.

Number of Electric Plants and Their Total Capacity

<u>Year</u>	<u>1918</u>	<u>1938</u>
Total number of electric plants	223	790
Total installed capacity	215	495
Average capacity per plant	0.955	0.625

Classification of Electric Plants According to Purpose

	<u>1918</u>					<u>1938</u>				
	<u>No</u>	<u>%</u>	<u>Cap</u> (mw)	<u>%</u>	<u>Avg Cap</u> <u>per Plant</u> (mw)	<u>No</u>	<u>%</u>	<u>Cap</u> (mw)	<u>%</u>	<u>Avg Cap</u> <u>per Plant</u> (mw)
Public power plants	90	40.4	80	37.2	0.801	300	38	200	40.4	0.665
Mixed power plants*	28	12.5	27	12.6	0.965	71	9	118	23.8	1.66
Industrial power plants	105	47.1	108	50.2	1.03	419	53	177	15.8	0.42

Classification of Electric Plants According to Fuel Used

Hydroelectric plants	168	21.6	160	32.3	0.952
Steam plants	306	38.6	208	42.0	0.68
Plants with diesel prime movers	(Information unavailable for 1918)				140 17.6 25 5.1 0.179
Plants with gas combustion prime movers	56	7.1	4	0.8	0.071
Plants with miscellaneous prime movers	120	15.1	98	19.8	0.816

*Mixed plants are those producing partially for public purposes.

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Small, local, uneconomic electric power plants were built in prewar Yugoslavia instead of large, powerful installations.

Of 168 hydroelectric power plants in 1938 with a total capacity of 160 milliwatts, two plants had a capacity of 104 milliwatts or 65 percent of the total capacity. The remaining 166 plants had a total capacity of 56 milliwatts, or an average of scarcely 0.34 milliwatt per plant. The same applies to thermal power plants and power plants using other types of fuel.

Only 160,000 kilowatts of water power were utilized before the war, or 1.78 percent of 9 million kilowatts, the potential hydroelectric power in Yugoslavia. Electrification was limited mostly to large cities, industries, and mines.

The production of electric power in 1939 was 1,100,000,000 kilowatt-hours, or 71 kilowatt-hours per capita.

Electric power in prewar Yugoslavia was transmitted over short distances only. The highest powered high-tension transmission line was an 80-kilovolt line, which supplied the northern part of Slovenia with electric power from the Fala Hydroelectric Plant on the Drava River. Of 4,654 districts (formerly called opcina) in 1938, only 713, or 15 percent, were supplied with electric power.

Five-Year Plan for Electrification

The Five-Year Plan calls for the production of electric power to be increased from 1.1 billion kilowatt-hours in 1939 to 4.35 billion kilowatt-hours in 1951. (This figure will be revised because the equipment for most of the new plants was ordered from the Eastern Bloc countries. The equipment will be produced domestically which will cause a delay in plan fulfillment.) This increase is to be achieved primarily through construction of hydroelectric plants, which are to be put into operation after 1951.

Thermal power plants are to be constructed as supplementary installations, primarily at mines, to utilize waste coal which cannot be transported long distances.

Industrialization currently under way all over Yugoslavia requires the construction of large electric installations to insure a sufficient supply of electric power for new factories. Electrification is also necessary for increasing the work productivity and living standard of working people.

After the liberation, electric power production developed at a rapid rate, increasing from 71 kilowatt-hours per capita in 1939 to 145 kilowatt-hours per capita in 1949, an increase of 105 percent.

The increase of electric power production in the individual republics for 1939 - 1949 was as follows:

<u>Republic</u>	<u>Production per Capita (kw-h)</u>				
	<u>1939</u>	<u>1946</u>	<u>1947</u>	<u>1948</u>	<u>1949</u>
Serbia	43	51	58	65	87
Croatia	90	72	110	114	136
Slovenia	240	330	400	615	620
Bosnia-Herzegovina	43	37	54	62	82

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<u>Republic</u>	<u>Production per Capita (kw-h)</u>				
	<u>1939</u>	<u>1946</u>	<u>1947</u>	<u>1948</u>	<u>1949</u>
Macedonia	7	16.5	19.5	24	28
Montenegro	1.5	1.7	1.9	3.2	10
Federal People's Republic of Yugoslavia	71	75.5	100	123	145

Electric power consumption in Yugoslavia from 1946 - 1949 was as follows (in million of kilowatt-hours):

<u>Year</u>	<u>Gen Consumption in Cities and Villages</u>		<u>Industry and Mining</u>		<u>Consumption of Power Plants</u>		<u>Total</u>
	<u>Million kw-h</u>	<u>%</u>	<u>Million kw-h</u>	<u>%</u>	<u>Million kw-h</u>	<u>%</u>	
1946	206	18	687	60	251	22	1,144
1947	262	18	902	62	291	20	1,455
1948	290	14.5	1,387	69	330	16.5	2,007
1949	328	15	1,530	70	320	15	2,186

Prewar Yugoslavia had 790 electric power plants, most of them small plants of local significance, which were utilized 2,250 hours annually, or 2.6 percent. This low degree of plant utilization shows not only the low level of industrialization but also the low level of connections between plants. The total length of power lines was only 1,200 kilometers. Today, plants are utilized 4,400 hours annually, or over 50 percent.

Thirty-one hydroelectric plants called for by the Five-Year Plan are under construction, with a total capacity of 785,575 kilowatts, which can produce an average of 3,010,000,000 kilowatt-hours annually. These hydroelectric plants are distributed as follows:

<u>Republic</u>	<u>No of Plants</u>	<u>Capacity (mw)</u>	<u>Avg Production (million kw-h)</u>
Serbia	8	176,195	625,680
Croatia	3	89,540	215,065
Slovenia	5	131,600	795,500
Bosnia-Herzegovina	6	215,600	1,025,930
Macedonia	6	164,780	340,300
Montenegro	3	7,560	41,132
Federal People's Republic of Yugoslavia	31	785,575	3,010,577

The largest hydroelectric plants under construction are the Jablenica, Mavrovo, Vlasina-Vrla, Vinodol, Mariborski Otok, Zvornik, and Vuzenica plants.

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Jablanica Hydroelectric Power Plant

At the bend of the Neretva River at Jablanica, where the natural drop of the river is the strongest, a large concrete arch dam is being built downstream from the mouth of the Rama River to increase the natural drop and create a reservoir which will straighten out the Neretva. The area to be covered by the reservoir is 1,438 hectares. The reservoir stretches from Jablanica to Konjic and is about 25 kilometers long.

The average annual production of the Jablanica Hydroelectric Power Plant is to be 758 million kilowatt-hours. The plant is scheduled to be put into operation in 1952.

Mavrovo Hydroelectric Power Plant

Mavrovsko Polje, through which the Mavrovo River flows, and which is about 1,200 meters above sea level, is to be flooded for a reservoir so the gap at Mavrov Han, through which the Mavrovo River also flows, is to be closed by a dam. The flooded area will amount to 1,300 hectares.

The Radika River will also be channeled into the reservoir.

The average annual production of the Mavrovo Hydroelectric Power Plant is to be about 300 million kilowatt-hours. It is scheduled to be put into operation in 1952.

Vlasina-Vrla Hydroelectric Power Plant System

Vlasinsko Blato (seasonal lake), which is about 1,200 meters above sea level and through which the Vlasina River flows, is to be made a reservoir by closing the mountain gap through which the Vlasina flows.

Since the Vlasina River does not have enough water to fill the large reservoir, the Cermernik and Strvna streams will be channeled into the reservoir. The Bozica River, which is lower than the reservoir, will also be channeled into it. The reservoir will cover 12,000 hectares of unproductive land.

Water from the reservoir will be utilized by four installations, one below the other, which constitute the Vlasina-Vrla Hydroelectric Power Plant System.

Zvornik Hydroelectric Power Plant

The Zvornik Hydroelectric Power Plant will be constructed on the Drina River in Mali Zvornik. A dam is under construction in the river bed. The flooded area will cover 810 hectares. The plant is scheduled to begin operation in 1952. It is to supply western Serbia, Belgrade, part of the Vojvodina, and eastern Bosnia with electric power.

Vinodol Hydroelectric Power Plant

The Vinodol reservoir will be formed by shutting off the Lokvarka River at Lokve in Gorski Kotar with an earth dam. The second phase of construction calls for another reservoir close to the Lokvarka basin. These two reservoirs will be connected. The Vinodol Hydroelectric Power Plant is supposed to begin operation in 1951.

Maribor Island Hydroelectric Power Plant

The first generator unit of the Maribor Island Hydroelectric Power Plant was put in operation in 1948.

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Vuzenica Hydroelectric Power Plant

The Vuzenica Hydroelectric Power Plant, located on the Drava River, downstream from the Dravograd Hydroelectric Power Plant, is the first of three hydroelectric plants planned for the Drava River between Dravograd and Fala.

Moste Hydroelectric Power Plant

A dam is under construction at the Moste Hydroelectric Power Plant, to shut off the Sava River in Kavcka Klisura (defile). In 1951, during the first phase of construction, the plant is to produce 68 million kilowatt-hours of power. This plant is to supply power principally to industry.

Medvodje Hydroelectric Power Plant

Installations of the Medvodje Hydroelectric Power Plant are located on opposite banks of the Sava River, with a dam between them. The average annual production is to be 95 million kilowatt-hours. The plant is scheduled to be in operation in 1951.

Other hydroelectric plants under construction are the Ovcar-Banja, Medjuvršje, Raska, Seljasnica, Zavrelje, Ozalj II, Jajce II, Sapuncica, Pesocani, Dosnica, Glava Zete, Slap Zete, and Slap Une plants.

Hydroelectric power plants planned include the Rama, Jajce I, Vlasina-Vrta III, Vlasina-Vrta IV, Crvene Vode, Kokin Brod, Cetina, etc.

To date, hydroelectric power plants which have been put in operation are the Maribor Island, Savica, Bogatici, Mesici, Vlasenica, Sokolovica, Zrnovi, and Musovica Rijeka plants. Some of these plants are operating with only one generator unit. The total average annual production of these hydroelectric plants approximates 225 million kilowatt-hours.

Since the construction of dams is a special problem in building hydroelectric power plants, earth dams are being constructed wherever possible instead of concrete.

Thermal Power Plants and Heating Plants

Thermal power plants are being built primarily where fuel is available as a reserve. Supplementary plants are under construction where rivers do not supply enough water and where technical and economic reasons require such construction.

Two types of heating plants are planned, one type to supply large industrial areas or cities with thermal power and a smaller type intended to supply power to small industrial combines or large factories.

Newly planned thermal power plants and heating plants are being standardized to make planning and construction easier.

Four large thermal power plants are under construction in Kakanj, Lukavac, Sostanj, and Kolubara, respectively. All these plants are located near coal mines; Kakanj is near a brown-coal mine, while the others are near lignite mines. The Kakanj Thermal Power Plant will be equipped to utilize coal waste which previously could not be utilized.

Thermal plants under construction include the Konjscina and Banovici plants.

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Thermal power plants are distributed in Yugoslavia as follows:

<u>Republic</u>	<u>No of Plants</u>	<u>Output (mw)</u>	<u>Annual Production (million kw-h)</u>
Serbia	2	85.5	384
Croatia	1	14.8	60
Slovenia	1	80	360
Bosnia-Herzegovina	3	107.5	493
Macedonia	2	6.3	25
Montenegro	2	3	13.25
Federal People's Republic of Yugo- slavia	11	294.6	1,335

Heating plants are planned for Ljubljana, Zagreb, Belgrade, Varazdin, Brod, and Zrenjanin.

Of 11 thermal power plants under construction, five have been put in operation at Kostolac, Madjari, Bitolj, Plevlja, and Kotor, respectively.

The Zenica, Subotica, Aleksinac, Zvecane, Zvezdan, Vreoc, and Bor plants are being enlarged and several plants are being installed which were received as reparations.

High-tension transmission lines of 110,000 volts are being utilized for the high power networks, such as the Maribor Island, Fala, Dravograd, Velenje, Lasko, Rajhenburg, and Zagreb power plants.

High-tension transmission lines of 35,000 volts, with 10/35-kilovolt transformer stations, are used to connect power plants of medium capacity and to supply industries, cities, and large consumers.

To date, 110,000-volt high-tension transmission lines which have been put in operation temporarily at lower voltages are the Zagreb-Karlovac; Kakanj-Zenica-Doboj-Lukavac; Belgrade-Kostolac-Bor; Petrovac-Svetozarevo; Zemun-Novi Sad; and Skoplje-Titov Veles lines; and the lines from the Tito-Lozovac Hydro-electric Plant, the Plave-Doblar-Ljubljana power system, and the Mariborski Otok-Strnisce-Varazdin system.

High-tension transmission lines of 110,000 volts under construction are the Tito-Mostar-Jablanica-Sarajevo; Karlovac-Vinodol; Svetozarevo-Nis-Vlasina; and Svetozarevo-Rankovicevo lines. Transformer stations of 110/35 kilovolts are being built at the junctions of these power lines.

Also under construction are 35,000-volt lines and 10/35-kilovolt-transformer stations, some of which have already been completed and put in operation.

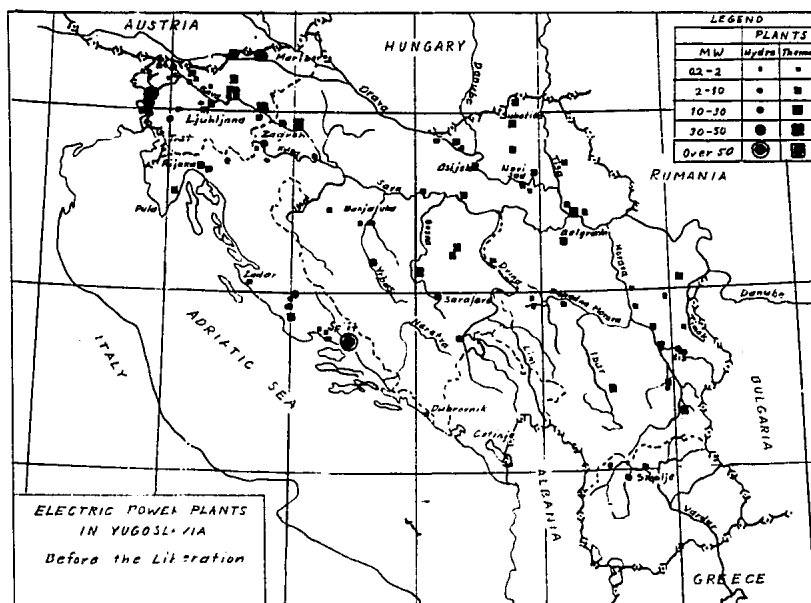
[Appended maps and graph follow.]

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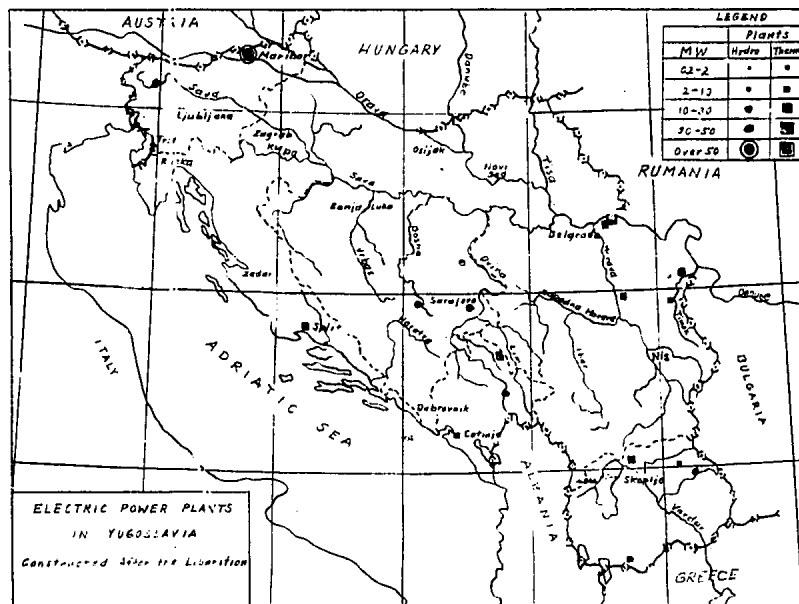
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Map 1



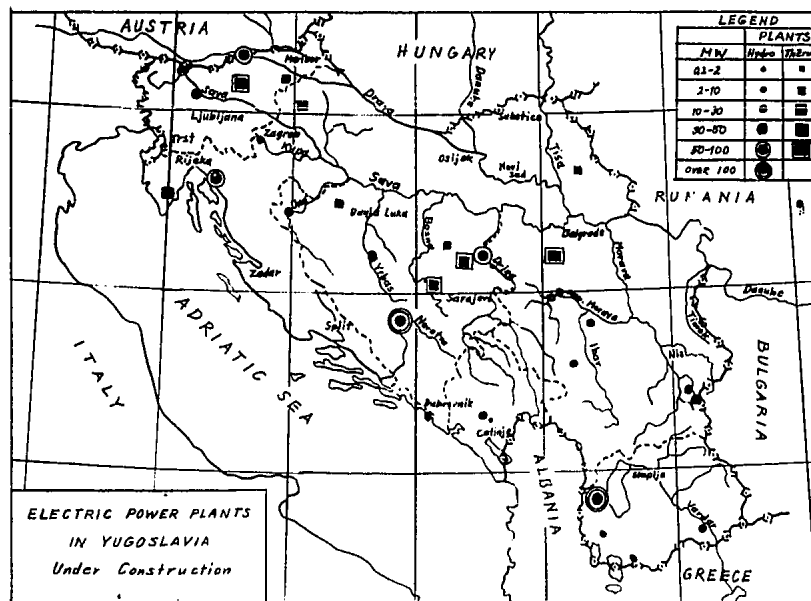
Map 2

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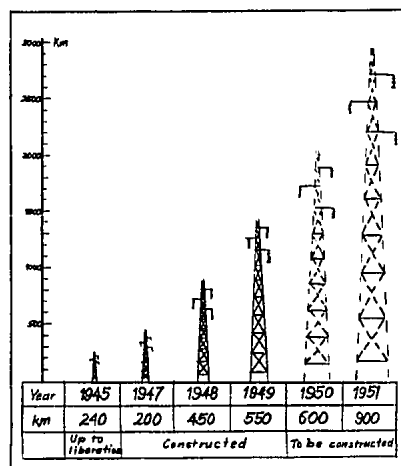
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Map 3

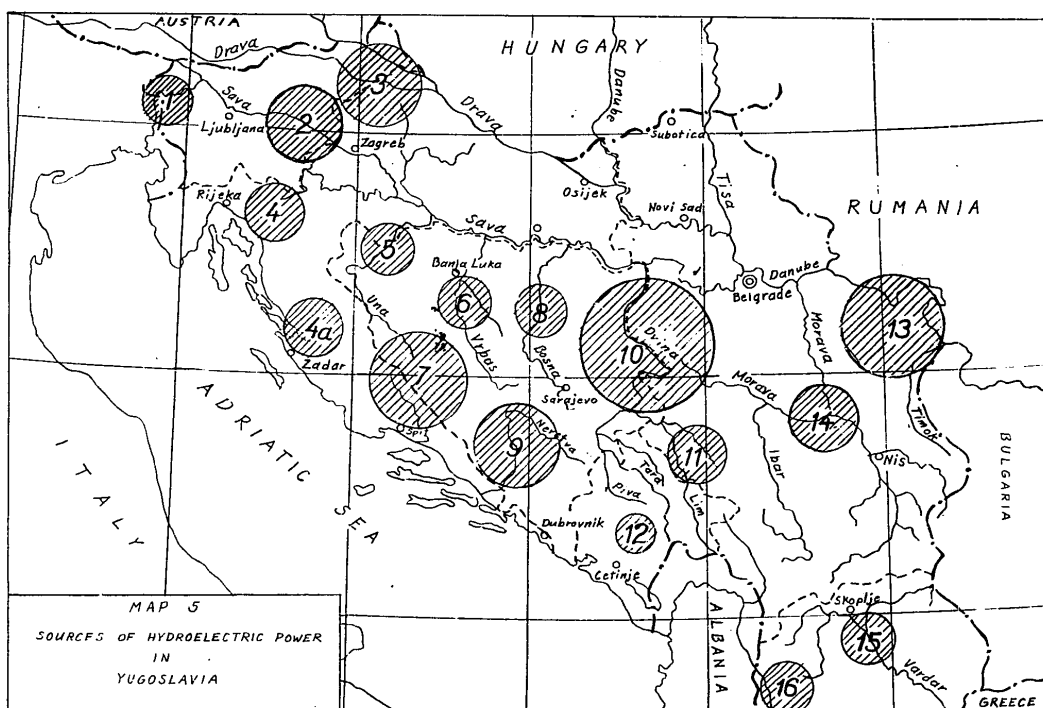


Map 4

High-Tension Transmission Line
Construction
(110 Kv)

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Legend



Main Sources of Hydroelectric Power

- (1) Drainage area of the Soca River (within Yugoslav boundaries)
- (2) Drainage area of the Sava River (from its source to the mouth of the Kupe River)
- (3) Drainage area of the Drava River
- (4) Coastal rivers
- (5) Coastal rivers
- (6) Drainage area of the Vrbas River
- (7) Drainage area of the Cetina River and enclosed karst fields
- (8) Drainage area of the Bosna River
- (9) Drainage area of the Neretva River
- (10) Drainage area of the Drina River
- (11) Drainage area of the Lim River
- (12) Hydrocenter in Montenegro
- (13) Danube - Djerdjap (Iron Gate, Yugoslav part)
- (14) Drainage area of the Morava River
- (15) Drainage area of the Vardar River
- (16) Drainage area of the Drim River (within Yugoslav boundaries)

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